

**United States Naval Academy
Mechanical Engineering Department**

EM474 Gas Turbines

Catalog Description: EM474 Gas Turbines

Credit: 3 (2-2-3)

A course designed to acquaint the student with the design and analysis of modern gas turbine engines currently employed by the U.S. Navy. The emphasis is on the constraints and limitations of the various components that comprise shaft power gas turbine engines such as axial and centrifugal compressors, combustors, axial and radial turbines, intercoolers, reheaters, regenerators and inlet/exit diffusers and nozzles. In addition, component matching and the problems associated with it will be studied. Also, future concepts in turbomachinery propulsion will be discussed. The course assumes a basic knowledge of thermodynamics and will add to the student's knowledge in such areas as compressible flow in turbomachinery, combustion analysis and emissions control. The culmination of the course is a final design project.

Prerequisites: EM319, EM320

Corequisites: None

Textbooks: Class Notes and Handouts

Course Director: Prof. Martin Cerza

Objectives¹:

1. To teach the student the engineering analysis and design of modern day gas turbine power systems that are utilized by the US Navy. Ship gas turbines analyzed will be both conventional and intercooled/recuperated gas turbines. The analyses will entail in-depth studies of inlets, combustors, axial and centrifugal compressors, axial turbines, intercoolers and recuperators/regenerators. Time permitting, advanced concepts will also be discussed.
2. The student will learn analytical and computational methods to predict the performance of the above mentioned components and how to match components such as an axial turbine and an axial compressor.
3. To familiarize the student with the diagnostics and working of such engines through laboratories.
4. The course will give 3 design credits. Several short term design projects relating to gas turbines will be worked on by midshipmen design teams.

Course Content:

No.	Topic or Subtopic	hrs.
1.	Introduction/Advanced Thermodynamic Concepts	5
2.	Thermodynamics of Gas Turbines	3
3.	Inlets/Combustors: Analysis and Design	4
4.	Axial Compressors: Analysis and Design	12
5.	Axial Turbines: Analysis and Design	12
6.	Centrifugal Compressors: Analysis and design	5
7.	Intercoolers/Recuperators	8
8.	Laboratory	8
9.	Miscellaneous	7

Evaluation:

1. Quizzes	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
2. Homework	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
3. Exams	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
4. Laboratory Reports	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
5. Oral Presentations	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
6. Design Reports/Notebooks	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
7. Prototypes/Demonstrations	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
8. Projects	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
9. any other evaluation tools used	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No

Acquired Abilities²:

For each Objective, list performance criteria and indicate which evaluation tools are used to assess the criteria.

1. Detailed knowledge of a working gas turbine as employed by the US Navy. (1,2,3,4)
2. Design knowledge of a working gas turbine. (1,2,3,4)
3. Organizing and operating in a project group to produce a completed design of an engineering system. (1,2,3,4)
4. Writing and presenting a design report. (1,2,3,4)
5. The use of computers in the design process. (1,2,3,4)

Date of Latest Revision: 21 NOV 2001

¹ Letters in parenthesis refer to the [Program Objectives](#) of the [Mechanical Engineering Program](#).

² Numbers in parenthesis refer to the evaluation methods used to assess student performance.